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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the suitable manufacturing method for manufacture of the bar tube material of high speed tool steel of hypoxia, or alloy tool steel, etc. especially about the manufacturing method of hypoxia metal powder products.

[0002]

[Description of the Prior Art]Since many elements are added, high speed tool steel and alloy tool steel are difficult to acquire a detailed uniform presentation with a uniform carbide particle size that a segregation happens to an ingot easily in manufacture by the ingoting method. However, toughness is able to be able to make a crystal grain detailed few in a segregation, and to be able to distribute carbide minutely and uniformly further, therefore to manufacture steel with good cutting ability highly with a powder method, if this is hardened and sintered since there is almost no segregation in the powder as bulk.

[0003]However, in manufacture of the high-speed steel by the conventional powder method. . [whether after carrying out pressure sintering of the powder obtained by the atomizing method by a hot isostatic press (HIP), it is considered as a product by a forge or extrusion, and] Or since it heated since it pressurized by the cold isostatic press (CIP) and the filling factor was raised, and the back forged, or extruded and carried out and it was considered as the product, there was a problem to which the powder surface oxidizes in a powder manufacturing process, the oxygen content of the product itself becomes high, and toughness, such as anti-*** of a product, becomes low.

[0004]As what solves the above-mentioned problem, atomization powder is lengthened and deaerated to a vacuum under an elevated temperature, and the method of lowering and carrying out hot forging of the amount of oxygen is proposed by JP,2-138403,A. By the method given in this gazette, since it is deaerated by the high temperature atmosphere near a vacuum

atmosphere, C and O in the end of steel powder react, a self-reducing action is promoted, and it is supposed that the oxygen density in a product can be made low.

[0005]However, also in this method, in order to deaerate to a vacuum at an elevated temperature, complicated equipment was applied, and the process was complicated, in order to take time above to carry out vacuum reduction moreover, cost became high and, in addition, there was a problem in practicality.

[0006]

[Problem(s) to be Solved by the Invention]Without being in canceling the problem of the above conventional technologies, and needing complicated equipment, the issue which this invention tends to solve is simple for a process, and there is in providing the manufacturing method of the bar tube-like products of powder high speed tool steel of practical and hypoxia cheap in cost, or alloy tool steel.

[0007]

[Means for Solving the Problem]A manufacturing method of hypoxia metal powder products in this invention for solving above-mentioned SUBJECT, 1) While being filled up so that metal atomization powder containing carbon may be extruded and it may become 85% or less of a filling factor to a capsule, Oxygen and affinity in oxidizing gas, such as oxygen, CO, CO₂, and H₂O, are strong in this extrusion capsule, Ta whose melting point oxygen is absorbed irreversibly and is not less than 1000 **, One sort of metal, such as Ti, Zr, Hf, Se, and Y, or these alloys or two sorts or more are inserted in, Hot extrusion is carried out after ***** (ing) this capsule at not less than 1000 ** after decompressing and sealing inside of a capsule below to 10⁻¹ atm at a room temperature, and carrying out fixed time maintenance, 2) While being filled up so that metal atomization powder containing carbon may be extruded and it may become 85% or less of a filling factor to a capsule, Oxygen and affinity in oxidizing gas, such as oxygen, CO, CO₂, and H₂O, are strong in this extrusion capsule, After absorbing oxygen irreversibly, and the melting point's inserting in one sort of metal, such as Ta, Ti, Zr, Hf, Se, Y, etc. which are not less than 1000 **, or these alloys, or two sorts or more and deaerating and sealing inside of a capsule below to 10⁻¹ atm in a low temperature region 500 ** or less, ***** (ing) this capsule at not less than 1000 **, carrying out, ranking second and carrying out hot forging of the hot isostatic press, low application of pressure of 5 or less MPa, or after are non-energized and carrying out fixed time maintenance -- it consists of things.

[0008]This invention atomization metal powder which contains the carbon when it contains carbon of sufficient quantity required for oxygen reduction, Are filled up so that it may become 85% or less of a filling factor in a capsule, and in this extrusion capsule further Oxygen and CO, Oxygen and affinity in oxidizing gas, such as CO₂ and H₂O, are strong, and oxygen is

absorbed irreversibly, and the melting point inserts in one sort of metal, such as Ta, Ti, Zr, Hf, Se, Y, etc. which are not less than 1000 **, or these alloys, or two sorts or more.

Subsequently, an oxide on the surface of metal powder in a capsule is uniformly returned by ***** (ing) in temperature of not less than 1000 **, and carrying out fixed time maintenance. By making a filling factor of powder in a capsule 85% or less, many free interfaces remain in atomization metal powder, and a reducing action of oxygen by carbon in powder is more effectively promoted. since a capsule is decompressed below at 10^{-1} atm, quantity of oxygen in a capsule also has only few the parts -- a powdered product of hypoxia is obtained.

[0009]A powdered product of more stable hypoxia is obtained by inhibiting oxidation reaction at the time of temperature up by carrying out reaction adsorption of the oxygen in returned oxidizing gas with metal inserted in in a capsule, such as Ti and Ta.

[0010]

[Example]As an example of this invention, the gas atomization metal powder with a mean particle diameter of 100 micrometers of the chemical entity of a statement to Table 1 150 mm in diameter made from a mild steel plate. The 680-mm-high cylinder capsule was filled up with the filling factor shown in Table 2 and 3, and 400g of Ti was further inserted in in this capsule, and it sealed, after carrying out the temporary seal by welding and deaerating at a room temperature.

[0011]

[Table 1]

供試材の化学成分										(%,ただしOはppm)
No	C	Si	Mn	Ni	Cr	Mo	V	W	Co	O
1	1.30	0.30	0.40	0.33	4.20	4.95	3.00	5.90	0.20	85
2	1.31	0.25	0.35	0.25	4.00	5.00	3.10	6.05	0.05	90
3	2.30	0.35	0.34	0.28	4.10	7.05	6.50	6.50	10.10	100
4	0.40	0.80	0.40	0.15	5.50	1.20	0.55	0.03	0.03	110
5	1.42	0.25	0.40	0.15	11.20	0.85	0.20	0.02	0.02	95
6	0.98	0.28	0.34	0.21	16.30	0.40	0.07	0.06	0.01	80

[0012]Subsequently, after deaerating and sealing in a low temperature region 500 ** or less, ***** temperature up of this capsule is carried out to the proper elevated temperature according to a not less than 1000 ** ingredient, In order to advance the reduction reaction by carbon in powder and to deoxidize, after carrying out fixed time maintenance at this temperature, . [whether furthermore, after carrying out fixed time maintenance, hot-extrusion processing is performed to the hot-extrusion optimal temperature according to an ingredient, and] or it ***** (ed) at not less than 1000 **, and fixed time maintenance was carried out by the low pressurization state of 5 or less MPa at the optimal hot isostatic press temperature according to an ingredient -- after temperature up was carried out and the forge performed the fabricating operation after the usual hot isostatic press. Such heating retention temperature,

retention time, hot-extrusion processing conditions or hot isostatic press processing conditions, and the obtained oxygen content of a product are shown in Table 2 and 3.

[0013]As a conventional method, like the above gas atomization metal powder with a mean particle diameter of 100 micrometers 150 mm in diameter made from a mild steel plate. The thing which heated the billet obtained by carrying out pressing by a cold isostatic press after filling up a 680-mm-high cylinder capsule to a predetermined temperature and which carried out after hot-extrusion processing and was used as the product, And after carrying out temperature up and carrying out a hot isostatic press at a predetermined temperature, pressurizing, the amount of oxygen of thing ** used as the product by forging is shown in Table 2 and 3.

[0014]

[Table 2]

供試材 (No)	本 発 明 法							従来法
	熱 間 押 出 し 法							熱間押出法
	充填率 (%)	加圧真空度 (atm)	昇温時間 (hr)	加熱温度 (°C)	保持時間 (hr)	残留O ₂ (ppm) 吸着金属装入 外周 中心		残留O ₂ (ppm)
1	80	$\leq 10^{-1}$	3	1200	2	30	25	80
2	75	"	3.5	1200	2.5	30	30	90
3	70	"	3.5	1100	2.5	25	20	90
4	75	"	3	1200	2	30	25	100
5	70	"	3	1150	2	35	40	90
6	65	"	3	1220	2	35	30	90

[0015]

[Table 3]

供試材 (No)	本 発 明 法							従来法
	熱 間 静 水 圧 プ レ ス 法							熱間静水圧 プレス法
	充填率 (%)	加圧真空度 (atm)	昇温時間 (hr)	加熱温度 (°C)	保持時間 (hr)	残留O ₂ (ppm) 吸着金属装入 外周 中心		残留O ₂ (ppm)
1	75	$\leq 10^{-1}$	4	1100	2	75	30	90
2	75	"	"	1000	"	25	25	100
3	65	"	"	1000	"	25	30	100
4	80	"	"	1150	"	40	25	110
5	70	"	"	1100	"	40	40	100
6	70	"	"	1150	"	30	35	90

[0016]As shown in Table 2 and 3, the product by a conventional method has an oxygen content as high as 80-110 ppm, and this is almost the same as the oxygen content in the starting material of Table 1. On the other hand, the oxygen content in the central part of the product of this invention is 20-40 ppm, and it turns out that the product of hypoxia is extremely

obtained with 75 ppm or less also in a peripheral part for a short time. The same effect is checked when metal or alloys, such as Ta other than Ti and Zr, are inserted in.

[0017]

[Effect of the Invention]As explained above, fill up with this invention the atomization metal powder which contains carbon of a complement in reduction so that it may become 85% or less of a filling factor to an extrusion capsule, and. Oxygen and affinity in oxidizing gas, such as oxygen, CO, CO₂, and H₂O, are strong to this extrusion capsule, When oxygen is absorbed irreversibly and the melting point inserts in one sort of metal, such as Ta, Ti, Zr, Hf, Se, Y, etc. which are not less than 1000 **, or these alloys, or two sorts or more, As many free interfaces as possible are made to remain in atomization metal powder, further, the inside of a capsule is decompressed below to 10⁻¹ atm, and the amount of oxygen is lessened.

Therefore, the reducing action of oxygen by carbon in powder can be more effectively gone on only by carrying out heating maintenance, and the powdered product of hypoxia is obtained more as compared with a conventional method.

[0018]Oxygen and affinity in oxidizing gas, such as Ti, are strong, and since the metal or the alloy which absorbs oxygen irreversibly is inserted in in a capsule, the powdered product of the small hypoxia of variation can be further obtained to homogeneity to outside - inner circumference.

[Translation done.]